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Delta sediment measurements to support numerical modeling of turbidity

Scott Wright, David Schoellhamer, Tara Morgan
USGS Sacramento

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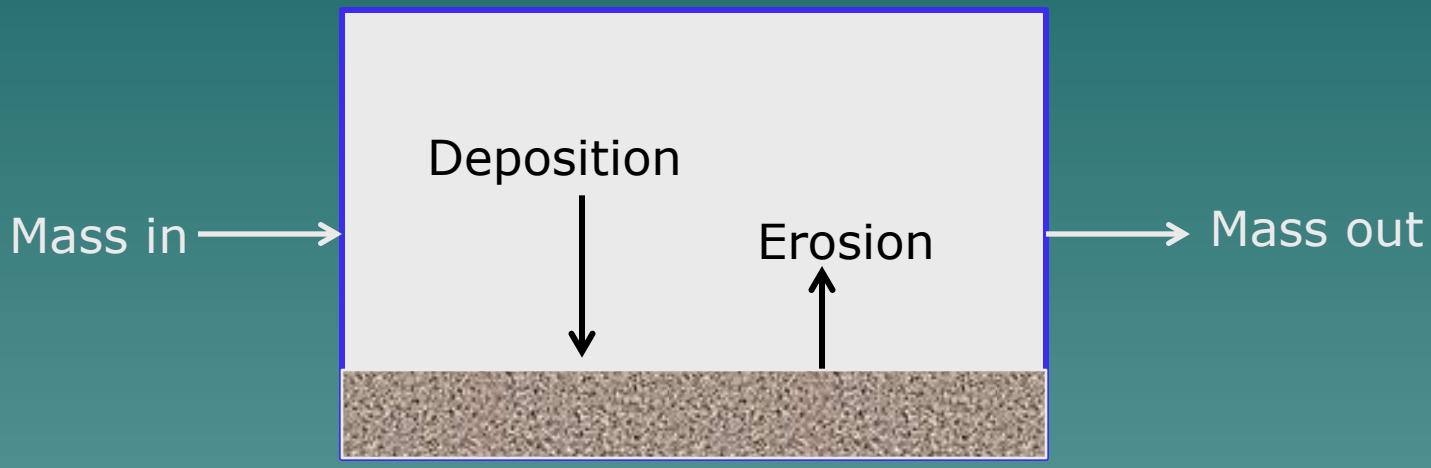
Turbidity/sediment modeling

All sediment models are based on conservation of sediment mass



Turbidity is a great monitoring tool, but it cannot be modeled directly

For models, we need relations between turbidity and mass concentration

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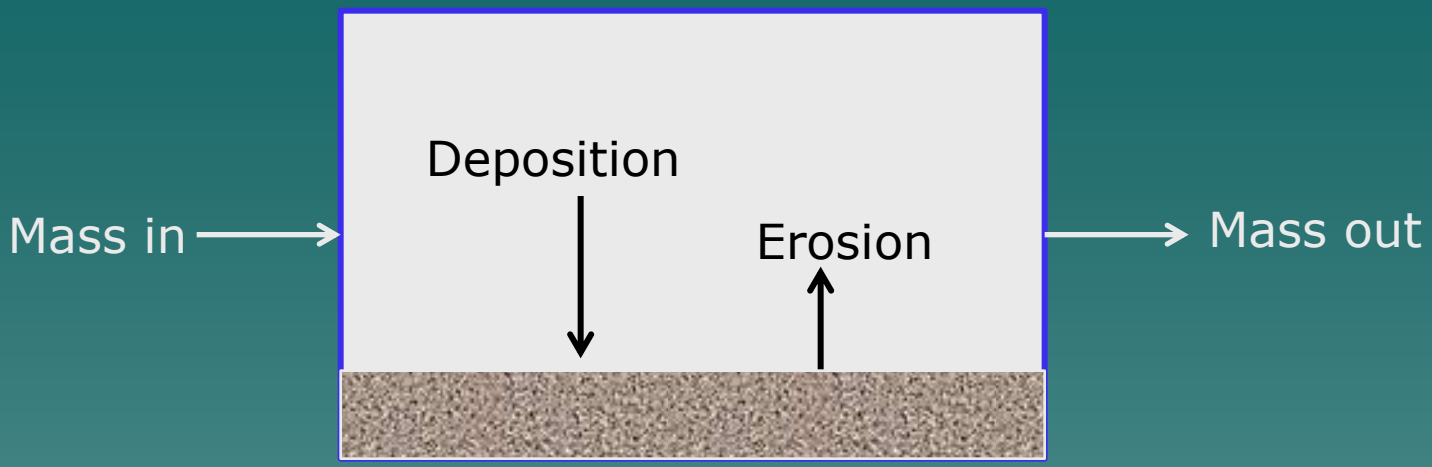
Model requirements



Boundary conditions: Amount of sediment coming into the Delta (task 1)

Model parameters: Particle size, settling velocity, erosion and deposition rates, flow resistance (task 2)

Calibration data: Suspended and bed sediment information (e.g. flux) at interior Delta sites (tasks 1 and 2)

The focus of this project is to collect these data

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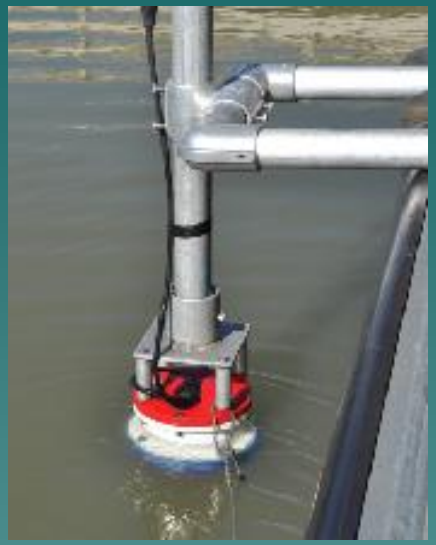
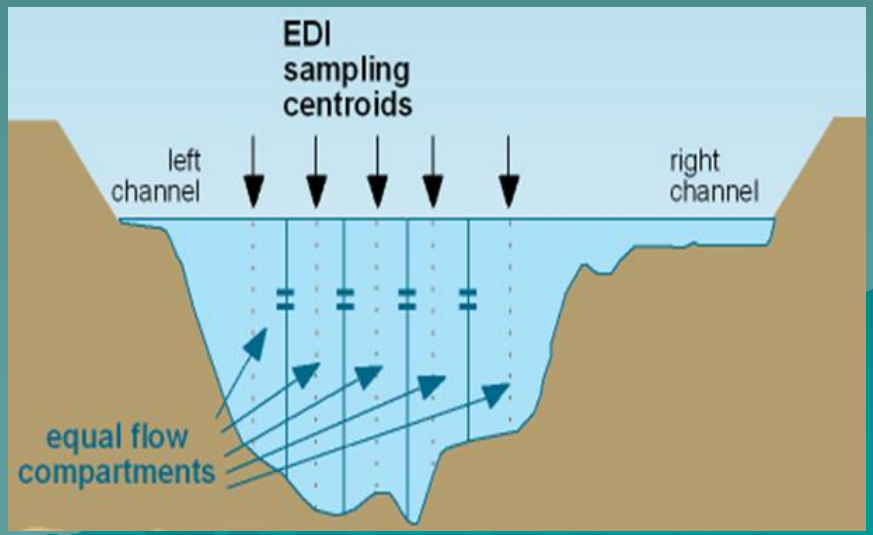
Task 1: Flow, turbidity, and suspended sediment measurements





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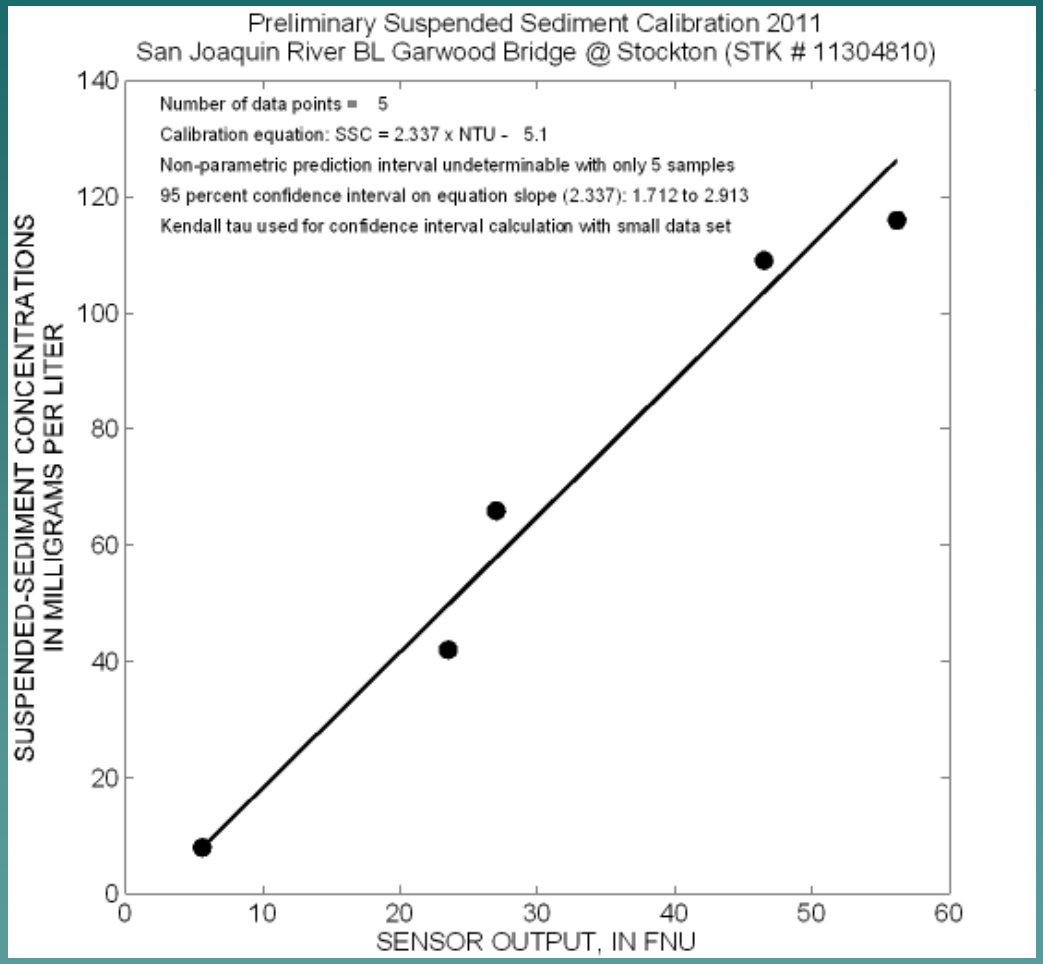
Turbidity versus sediment concentration



For models and process studies, we need to convert turbidity to suspended-sediment concentration

Monthly and event-based suspended-sediment sampling is used to develop turbidity to concentration calibrations

Sediment flux is then computed from concentration and water discharge

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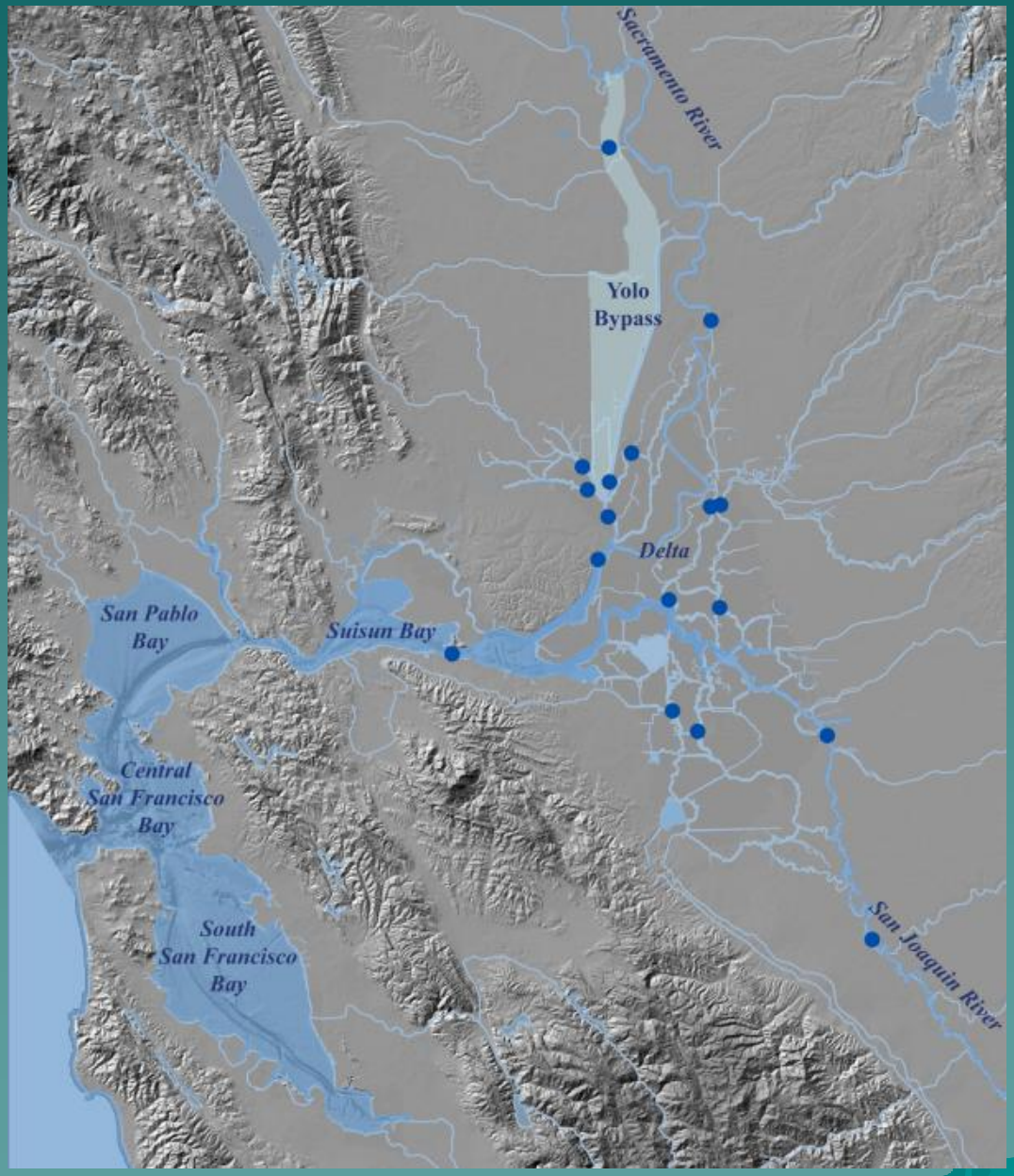
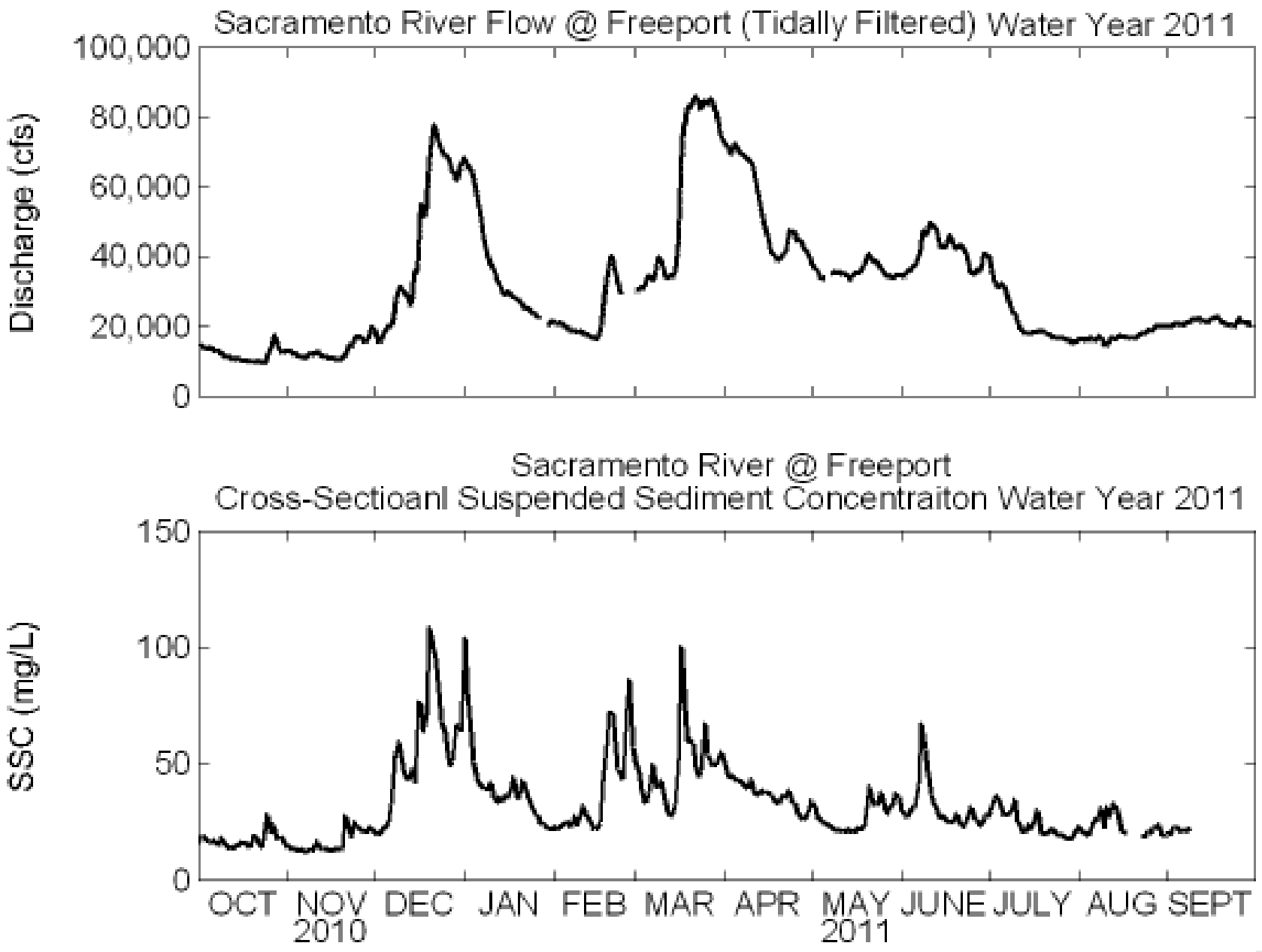
Monitoring network



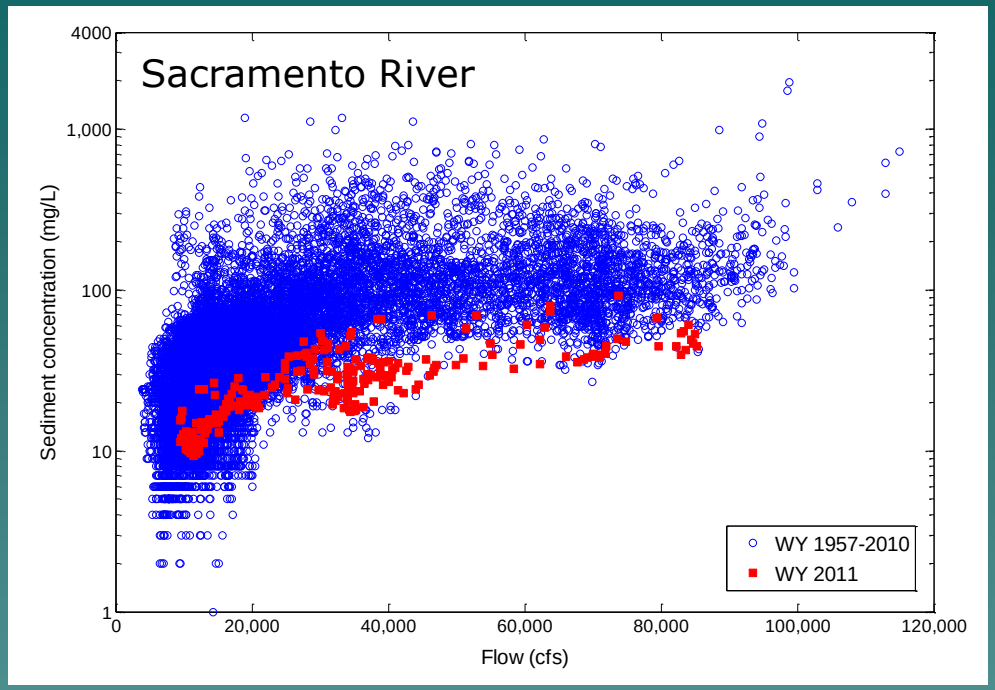
17 sediment flux stations (multiple projects), co-located with flow gages

Network is designed to monitor incoming sediment loads (boundary conditions) and track movement of sediment/turbidity throughout the Delta (calibration)

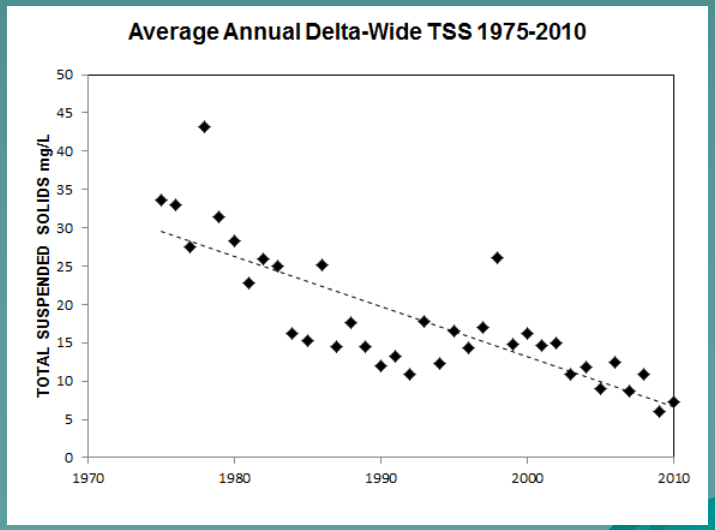
WY 2011 – Sacramento River

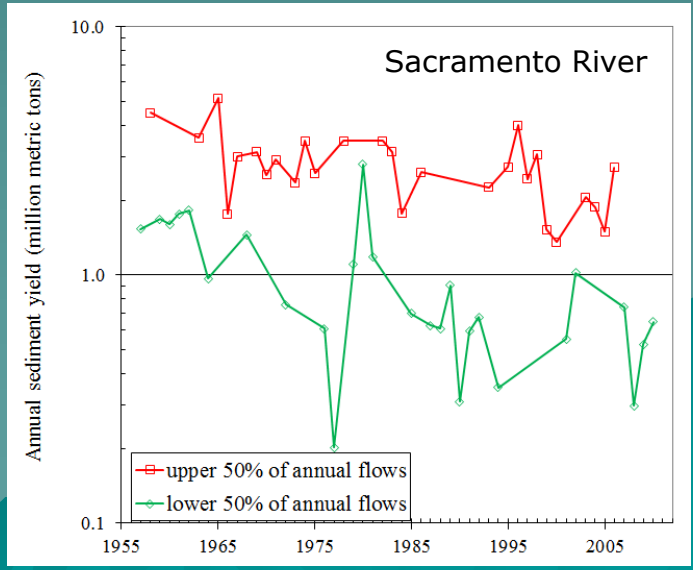


WY 2011: High flows, not much sediment



Consistent with previous research documenting a declining sediment supply to the Delta





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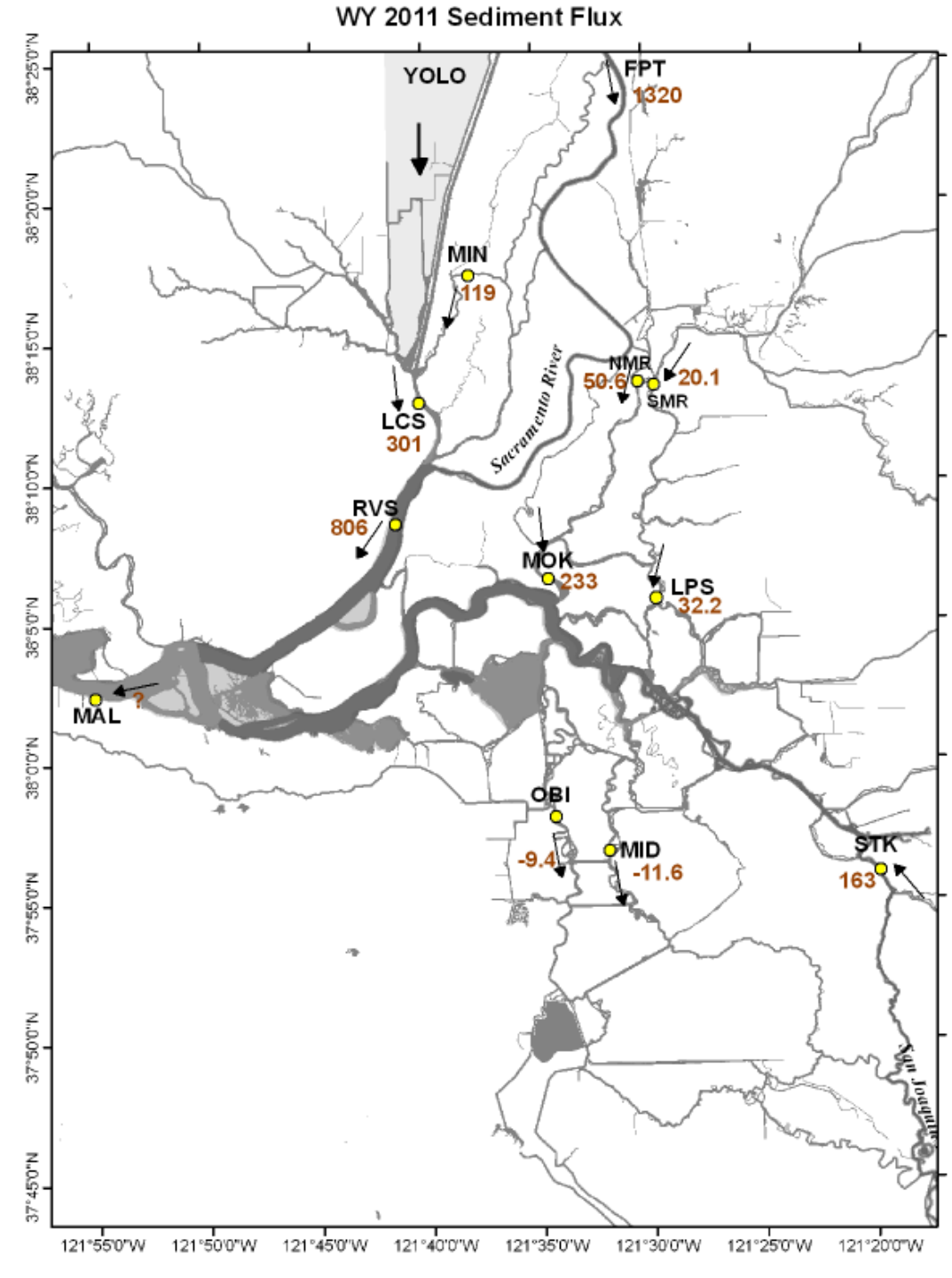


WY2011 preliminary sediment fluxes

Sediment budgets can be computed for various regions and time periods (e.g. first flush, snowmelt, etc)

Each site has 15-min records of flow, turbidity, sediment concentration and flux

Provides model boundary conditions and calibration data

Task 2: Modeling parameters

- Suspended-sediment particle size distributions
- Flow resistance/drag
- Near-bed turbulent sediment fluxes

LISST-100: volume concentration and particle size

ADV: 3D velocity and turbulence

Multi-parameter sonde: depth, turbidity, temperature, conductivity

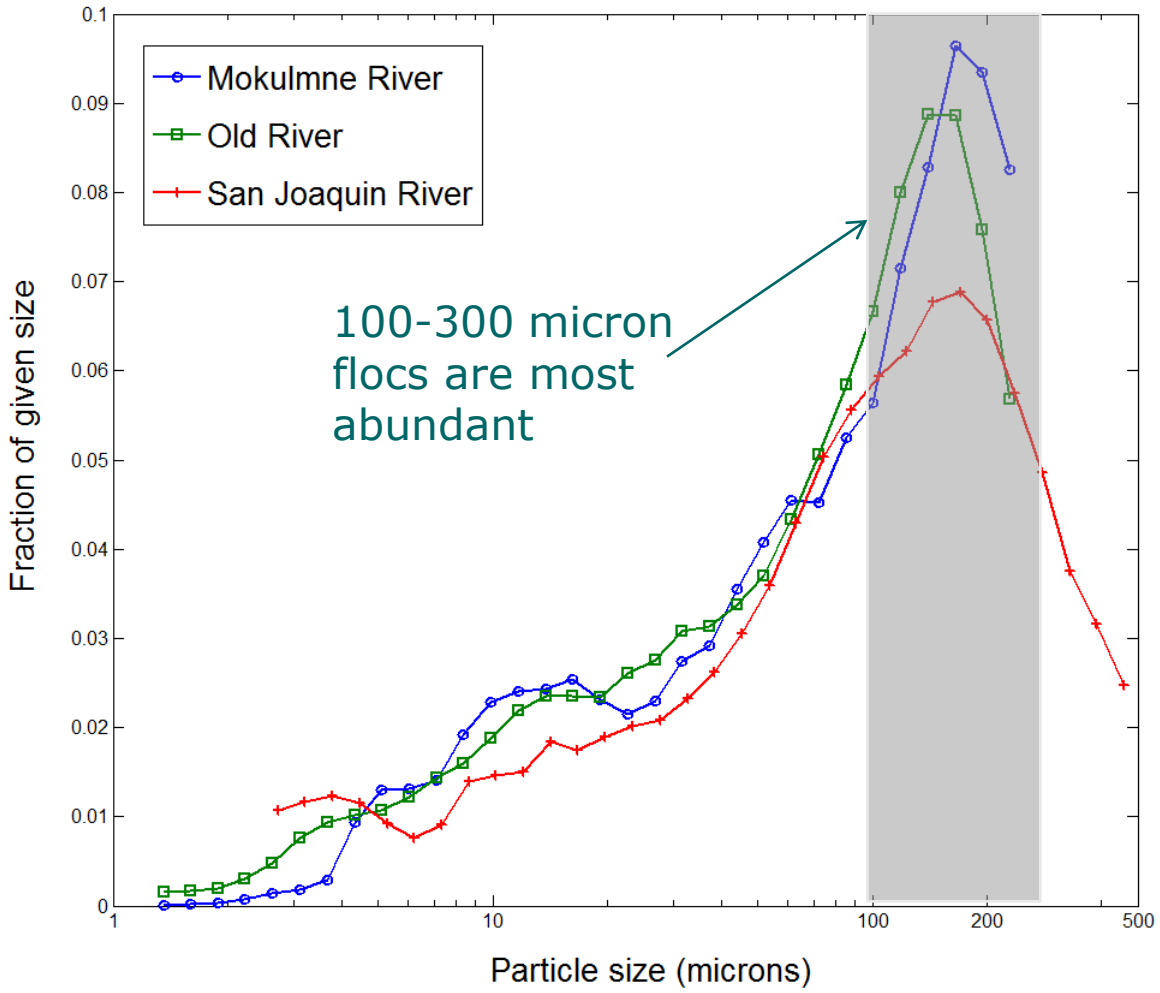
Task 2: Modeling parameters

- Bed sediment particle size distributions
- Settling velocity of flocs
- Bed sediment erodibility

Bed sediment sampler

Floc sampler

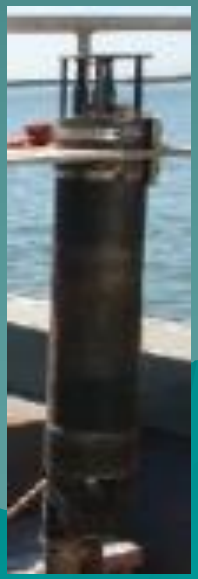
Suspended-sediment particle sizes



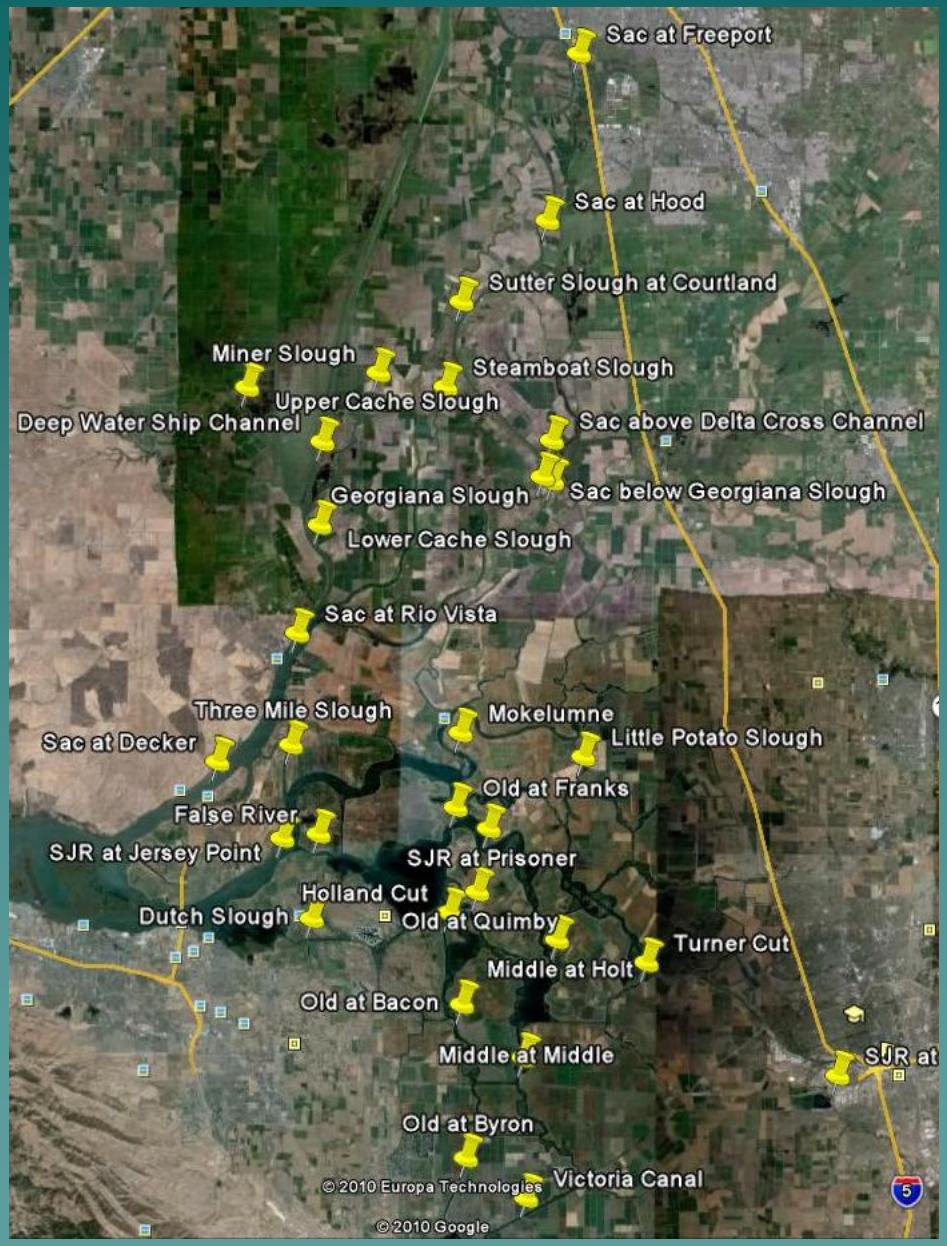
Measured in situ with LISST-100

Primarily flocculated particles (clay and silt primary particles)

Models require particle sizes and/or settling velocity as input



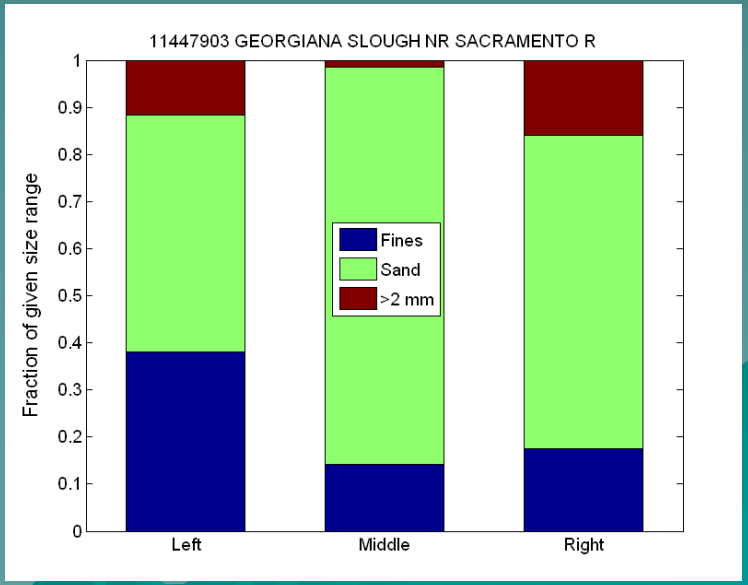
Bed sediment particle sizes



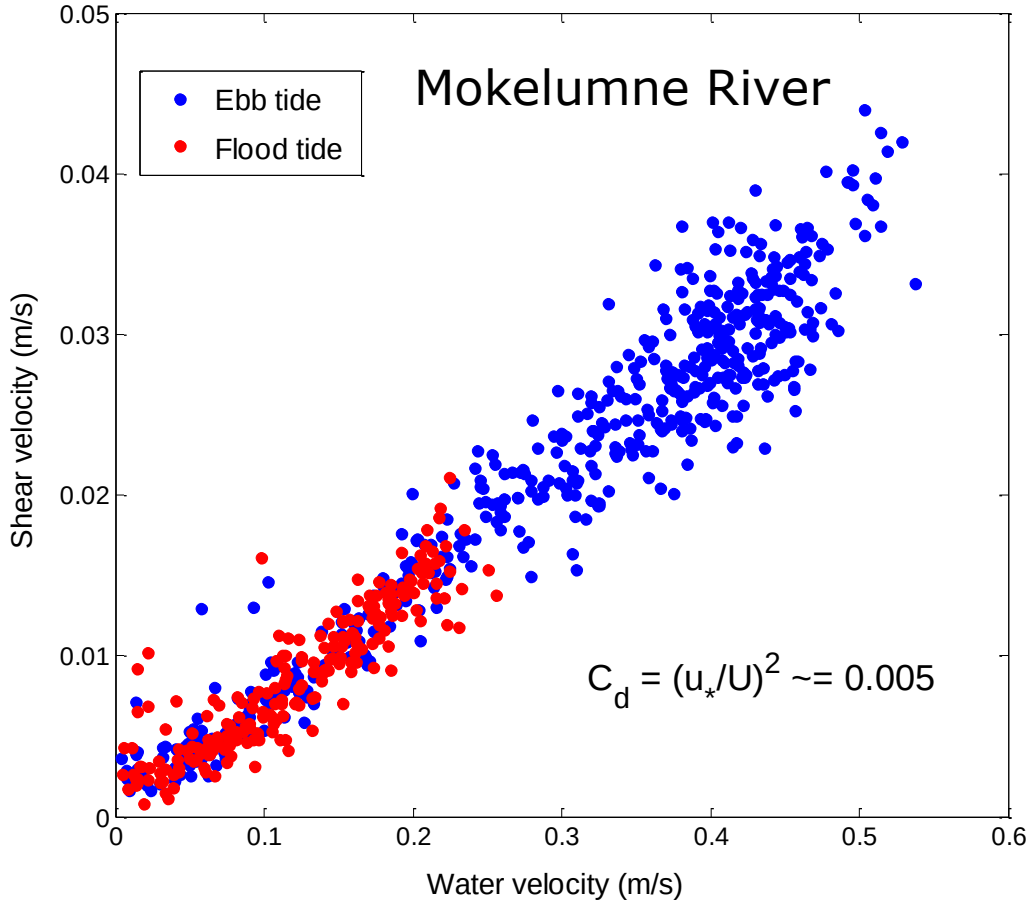
Seasonal sampling, before and after the winter wet season, at 30 sites (flow gage locations)

Document regions of deposition and erosion (by changes in bed sediment texture)

Needed to initialize models and for calibration and testing



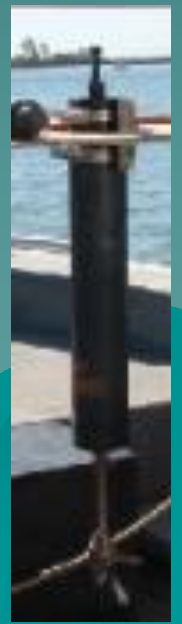
Flow resistance – drag coefficients



ADV measures near-bed velocity and turbulence: estimates of drag at the bed of the river

Drag coefficient (e.g. Manning's n) directly influences flow velocity and sediment transport

Primary calibration parameter for hydrodynamic models



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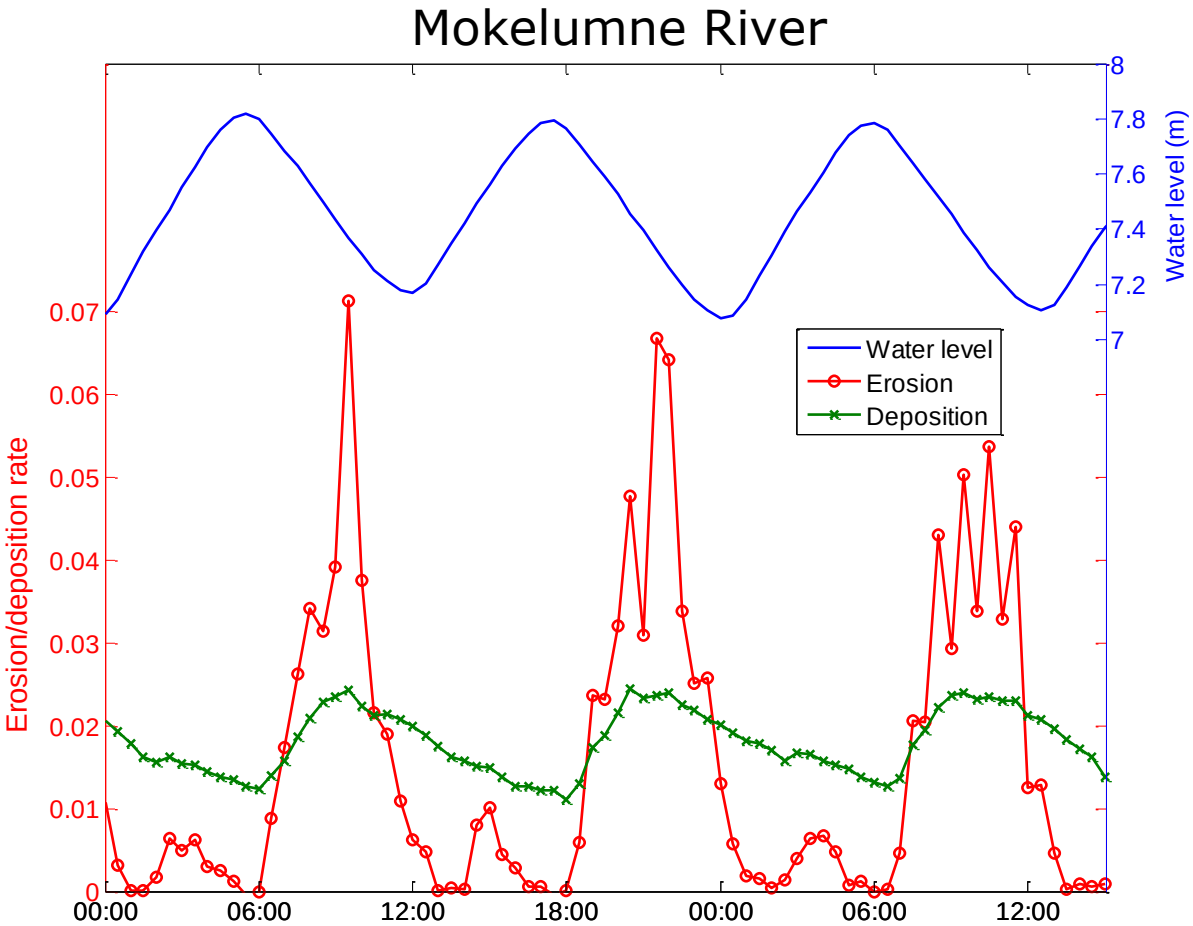
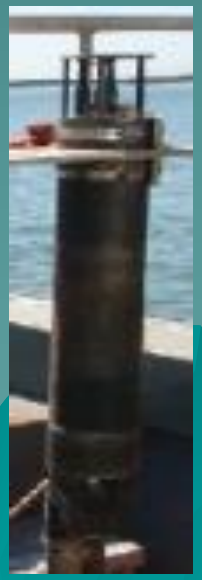
Erosion and deposition rates

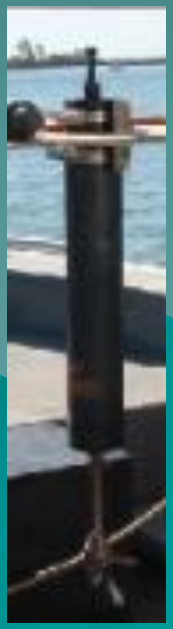


Measured with ADV and LISST-100

Documents repeating cycles of erosion (ebb tide) and deposition (flood and slack tides)

Models need to reproduce this behavior



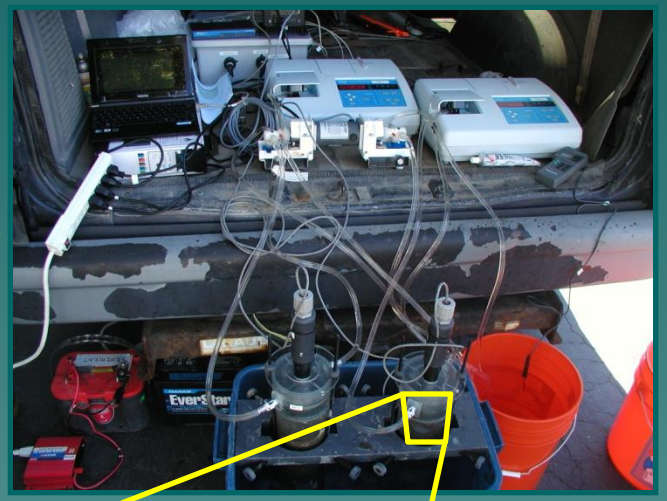


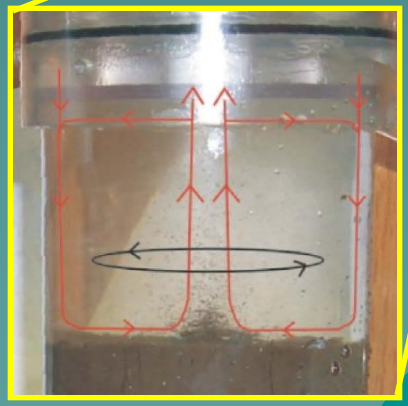
Bed sediment erodibility

Gomex corer

Subsample

Erosion Microcosm System





Flow path

Core is collected and subjected to known rates of shear stress, erosion is measured

Results used to parameterize model erosion equations

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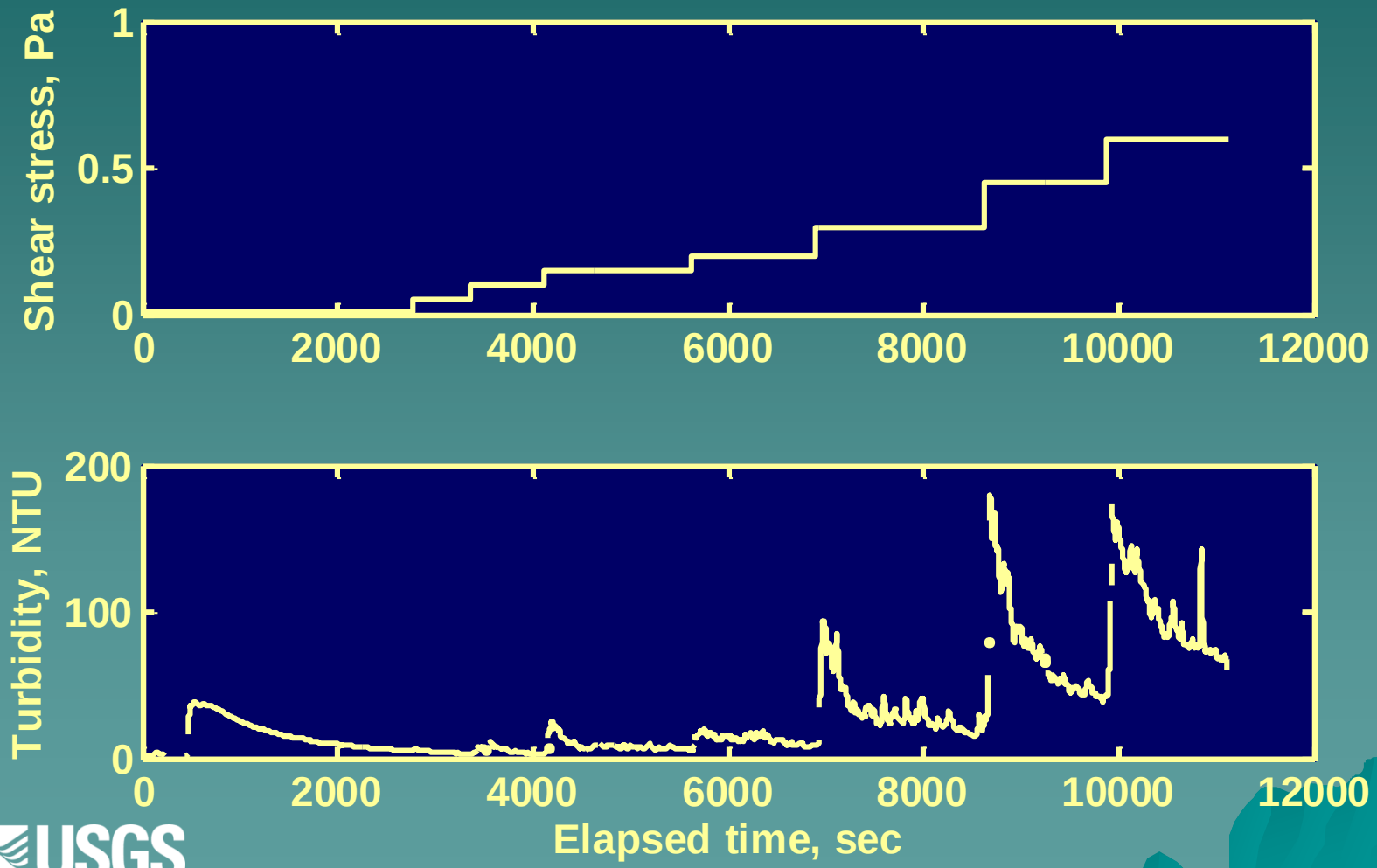
Bed sediment erodibility

Recent example from Mokelumne River



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Settling velocity – floc camera

Samples are collected and video is recorded *in situ* (on the boat) of individual flocs settling

Results used, along with particle size distributions, to parameterize model deposition equations

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Summary

- We have collected a lot of data in the past year. The dataset will be excellent for building and testing numerical models, and improve our understanding of sediment transport processes in the Delta. The program is continuing this water year

- We are in the process of QA/QC, data analysis, and preparation of documentation/publications

- We are fielding data requests from various modeling groups and are doing our best to respond to these given the preliminary nature of the data

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Questions?

Scott Wright

sawright@usgs.gov

916-278-3024

David Schoellhamer

dschoell@usgs.gov

916-278-3126

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